CLAIMS

What is claimed is:

1.   A force-feedback supply apparatus, comprising:

image generating means for generating a virtual reality image;

display means for displaying the virtual reality image generated by the image generating means;

force-feedback generating means for generating a force-feedback to be supplied to a user's finger in accordance with the virtual reality image;

force-feedback supply means mounted on the finger for supplying the force-feedback generated by the force-feedback generating means to the finger; and

image correcting means for correcting the virtual reality image generated by the image generating means, such that when a fingertip mounted with the force-feedback supply means comes in contact with a target object, the quantity of deviation corresponding to a thickness of the force-feedback supply means is removed from the virtual reality image displayed by the display means.

2.   A force-feedback supply apparatus, comprising:

image generating means for generating a virtual reality image;

display means for displaying the virtual reality image generated by the image generating means;

force-feedback generating means for generating a force-feedback to be supplied to a user's finger in accordance with the virtual reality image;

force-feedback supply means mounted on the finger for supplying the force-feedback generated by the force-feedback generating means to the finger; and

image correcting means for correcting the virtual reality image generated by the

image generating means, such that when two fingertips mounted with the force-feedback supply means come in contact with each other, the quantity of deviation corresponding to a thickness of the force-feedback supply means is removed from the virtual reality image displayed by the display means.

3.   A force-feedback supply apparatus according to Claim 1, wherein the display means displays an indication to the user, such that the virtual reality image is corrected by the image correcting means when the force-feedback supply means is first mounted on the user.

4.   A force-feedback supply apparatus according to Claim 1, further comprising position detecting means for detecting a position of the finger mounted with the force-feedback supply means in the virtual reality space,

wherein the image correcting means removes the quantity of deviation corresponding to the thickness of the force-feedback supply means on the basis of positional information of the two fingertips detected by the position detecting means.

5.   A force-feedback supply apparatus according to Claim 4, wherein the position detecting means detects positions of the fingertips in the virtual reality space, in a state where the two fingertips of the user mounted with the force-feedback supply means are at a reference posture, and

wherein the image correcting means corrects the virtual reality image on the basis of relative positional information of positions of the two fingertips when the two fingertips are in contact with each other and positions of the two fingertips at the reference posture, and relative positional information of positions of the two fingertips when the quantity of

deviation corresponding to the thickness of the force-feedback supply means is removed and the positions of the two fingertips at the reference posture, such that a position of one fingertip of the two fingertips in the virtual reality space is a position proportionally expanded from a position of the other fingertip between the position at the reference posture and the contact position when the quantity of deviation corresponding to the thickness of the force-feedback supply means is removed.

6.   A force-feedback supply apparatus according to Claim 1, wherein the image correcting means corrects the virtual reality image by offsetting the quantity of deviation corresponding to the thickness of the force-feedback supply means.

7.   A force-feedback supply apparatus according to Claim 1, wherein the force-feedback supply means comprises an arm section having a plurality of links and a plurality of joints for connecting the links, a force-feedback supply section mounted on the finger, and a connecting section for connecting the arm section and the force-feedback supply section to each other.

8.   A force-feedback supply apparatus according to Claim 7, wherein the force-feedback generating means comprises a plurality of actuators which are motors arranged in each of the plurality of joints.

9.   A force-feedback supply apparatus according to Claim 4, wherein the force-feedback supply means comprises an arm section having a plurality of links and a plurality of joints for connecting the links, a force-feedback supply section mounted on the finger, and a connecting section for connecting the arm section and the force-feedback

supply section to each other; the force-feedback generating means comprises a plurality of motors arranged in each of the plurality of joints; and the position detecting means detects the position of the fingertip by detecting respective rotational angles of the plurality of motors by means of a plurality of encoders connected to output shafts of the plurality of motors.

10. A force-feedback supply apparatus according to Claim 4, further comprising:

interference judging means for judging whether the finger interferes with the target object or not, on the basis of the positional information of the finger detected by the position detecting means in the virtual reality space and positional information of the target object predetermined in the virtual reality space; and

calculating means for calculating an operating force to be supplied to the finger on the basis of physical property data and state-quantity data of the target object when it is judged by the interference judging means that the finger interferes with the target object,

wherein the force-feedback generating means generates a force-feedback to be supplied to the user's fingertip by the force-feedback supply means on the basis of the calculation result of the calculating means.

11. An image correcting method of a force-feedback supply apparatus, comprising:

generating a virtual reality image;

displaying the generated virtual reality image;

generating a force-feedback to be supplied to a user's finger in accordance with the virtual reality image; and

supplying the force-feedback to the finger through a force-feedback supply section mounted on the finger;

wherein the virtual reality image is corrected, such that the quantity of deviation corresponding to a thickness of the force-feedback supply section is removed to bring the fingertip into contact with a target object in the virtual reality image displayed when the user's fingertip mounted with the force-feedback supply section comes in contact with the target object.

12. An image correcting method of a force-feedback supply apparatus, comprising:

generating a virtual reality image;

displaying the generated virtual reality image;

generating a force-feedback to be supplied to a user's finger in accordance with the virtual reality image; and

supplying the force-feedback to the finger through a force-feedback supply section mounted on the finger;

wherein the virtual reality image is corrected, such that the quantity of deviation corresponding to a thickness of the force-feedback supply section is removed to bring two fingertips into contact with each other in the virtual reality image displayed when the user's two fingertips mounted with the force-feedback supply section come in contact with each other.

13. An image correcting method according to Claim 11, wherein a position of the user's finger mounted with the force-feedback supply section in the virtual reality space is detected, and the virtual reality image is corrected to remove the quantity of

deviation corresponding to the thickness of the force-feedback supply section on the basis of the detected positional information of the fingertip.

14. An image correcting method according to Claim 12, wherein positions of the user's two fingertips in the virtual reality space are detected in a state where the user's two fingertips mounted with the force-feedback supply section are at a reference posture, positions of the two fingertips in a state where the two fingertips are in contact with each other are detected, positions of the two fingertips in the virtual reality space when the quantity of deviation corresponding to the thickness of the force-feedback supply section is removed are calculated on the basis of the positional information in a state where the two fingertips are in contact with each other, and the virtual reality image is corrected on the basis of relative positional information of the positions of the two fingertips at the reference posture and the positions of the two fingertips in a state where the two fingertips are in contact with each other or on the basis of the calculated positions of the two fingertips, such that a position of one fingertip of the two fingertips in the virtual reality space is a position proportionally expanded from a position of the other fingertip between the position at the reference posture and the contact position when the quantity of deviation corresponding to the thickness of the force-feedback supply section is removed.

15. An image correcting method according to Claim 12, wherein a position of one fingertip of the two fingertips to be displayed in the virtual reality image is corrected by offsetting the quantity of deviation corresponding to the thickness of the force-feedback supply section.

16.   A force-feedback supply apparatus according to Claim 2, wherein the display means displays an indication to the user, such that the virtual reality image is corrected by the image correcting means when the force-feedback supply means is first mounted on the user.

17.   A force-feedback supply apparatus according to Claim 2, further comprising position detecting means for detecting a position of the finger mounted with the force-feedback supply means in the virtual reality space,

wherein the image correcting means removes the quantity of deviation corresponding to the thickness of the force-feedback supply means on the basis of positional information of the two fingertips detected by the position detecting means.

18.   A force-feedback supply apparatus according to Claim 17, wherein the position detecting means detects positions of the fingertips in the virtual reality space, in a state where the two fingertips of the user mounted with the force-feedback supply means are at a reference posture, and

wherein the image correcting means corrects the virtual reality image on the basis of relative positional information of positions of the two fingertips when the two fingertips are in contact with each other and positions of the two fingertips at the reference posture, and relative positional information of positions of the two fingertips when the quantity of deviation corresponding to the thickness of the force-feedback supply means is removed and the positions of the two fingertips at the reference posture, such that a position of one fingertip of the two fingertips in the virtual reality space is a position proportionally expanded from a position of the other fingertip between the position at the reference posture and the contact position when the quantity of deviation corresponding to the

thickness of the force-feedback supply means is removed.

19.   A force-feedback supply apparatus according to Claim 2, wherein the image correcting means corrects the virtual reality image by offsetting the quantity of deviation corresponding to the thickness of the force-feedback supply means.

20.   A force-feedback supply apparatus according to Claim 2, wherein the force-feedback supply means comprises an arm section having a plurality of links and a plurality of joints for connecting the links, a force-feedback supply section mounted on the finger, and a connecting section for connecting the arm section and the force-feedback supply section to each other.

21.   A force-feedback supply apparatus according to Claim 20, wherein the force-feedback generating means comprises a plurality of actuators which are motors arranged in each of the plurality of joints.

22.   A force-feedback supply apparatus according to Claim 17, wherein the force-feedback supply means comprises an arm section having a plurality of links and a plurality of joints for connecting the links, a force-feedback supply section mounted on the finger, and a connecting section for connecting the arm section and the force-feedback supply section to each other; the force-feedback generating means comprises a plurality of motors arranged in each of the plurality of joints; and the position detecting means detects the position of the fingertip by detecting respective rotational angles of the plurality of motors by means of a plurality of encoders connected to output shafts of the plurality of motors.

23. A force-feedback supply apparatus according to Claim 17, further comprising:

interference judging means for judging whether the finger interferes with the target object or not, on the basis of the positional information of the finger detected by the position detecting means in the virtual reality space and positional information of the target object predetermined in the virtual reality space; and

calculating means for calculating an operating force to be supplied to the finger on the basis of physical property data and state-quantity data of the target object when it is judged by the interference judging means that the finger interferes with the target object,

wherein the force-feedback generating means generates a force-feedback to be supplied to the user's fingertip by the force-feedback supply means on the basis of the calculation result of the calculating means.

24. An image correcting method according to Claim 12, wherein a position of the user's finger mounted with the force-feedback supply section in the virtual reality space is detected, and the virtual reality image is corrected to remove the quantity of deviation corresponding to the thickness of the force-feedback supply section on the basis of the detected positional information of the fingertip.

25. A force-feedback supply apparatus comprising:

a virtual reality image generator;

a display communicating with the image generator and displaying a virtual reality image generated by the image generator;

a force-feedback generator generating force-feedback to be supplied to a user's

finger, the force-feedback corresponding to the virtual reality image on the display;

a force-feedback supplier mounted on the finger and communicating with the force-feedback generator, the force-feedback supplier supplying the force-feedback to the finger; and

an image corrector communicating with the image generator and correcting the virtual reality image generated by the image generator such that when a finger mounted with the force-feedback supplier comes in contact with a target object, a deviation corresponding to a thickness of the force-feedback supplier is removed from the virtual reality image on the display.